FIG. 1

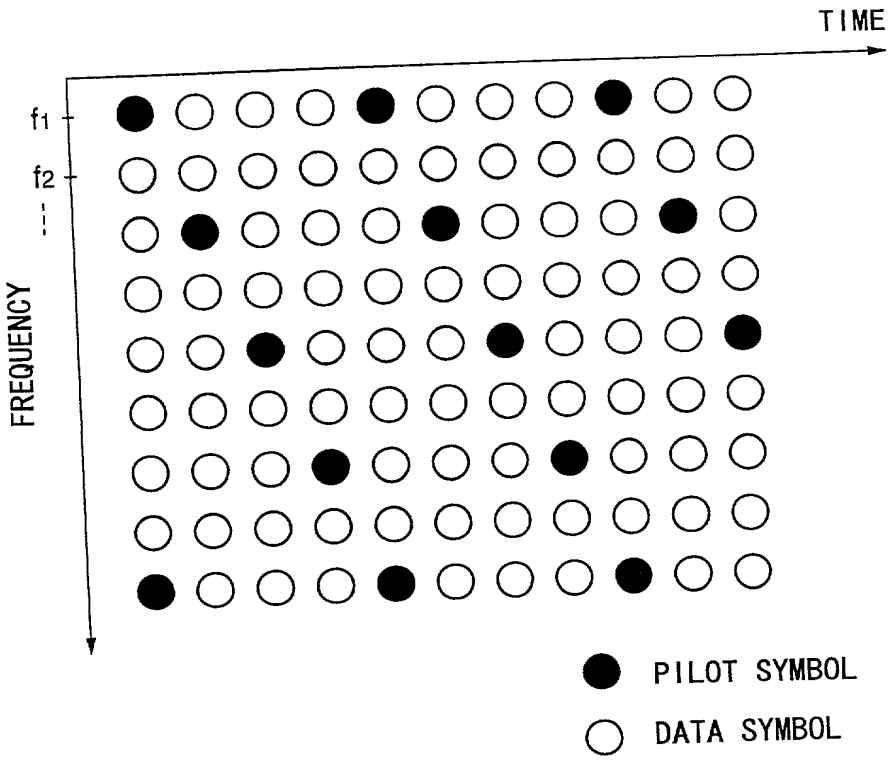


FIG.2

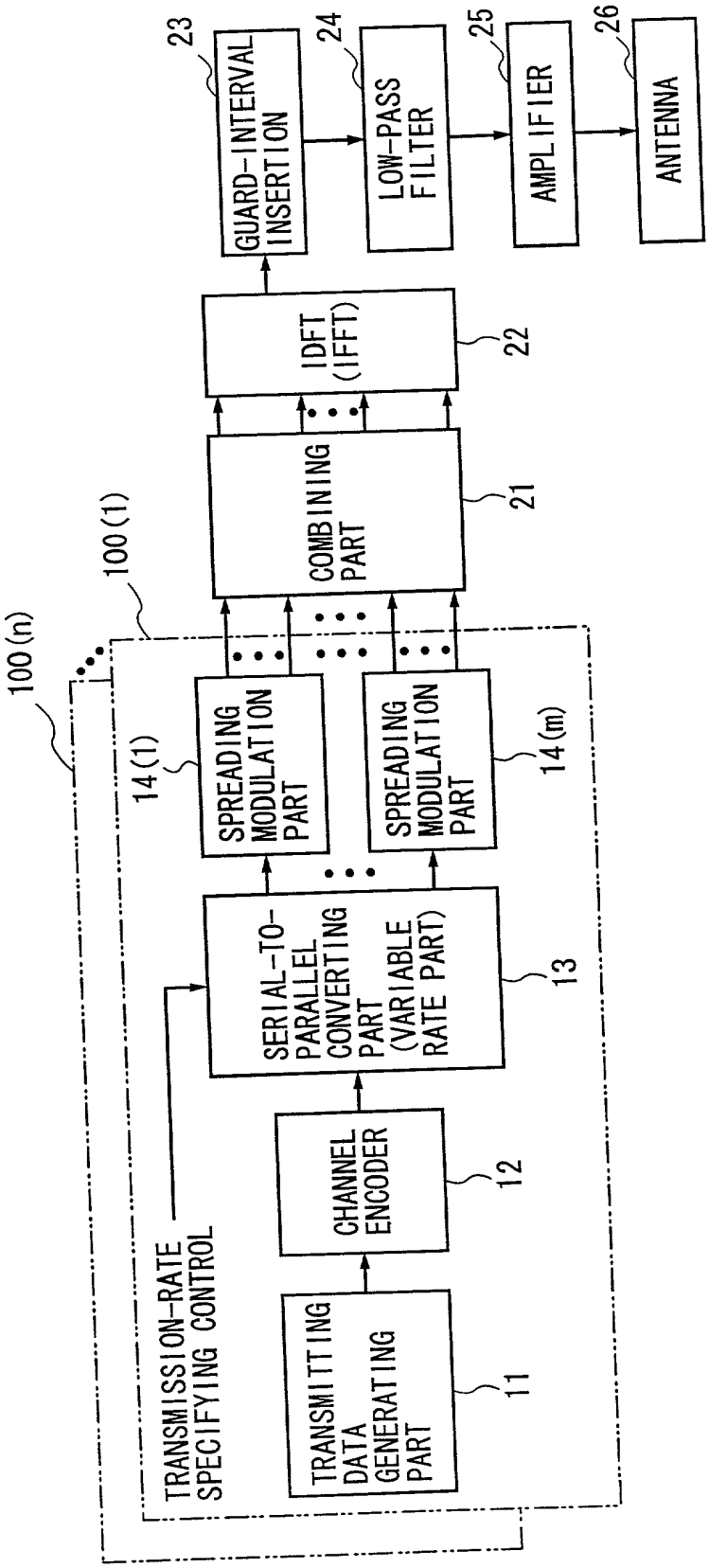

100(n)
100(1)
TRANSMISSION-RATE SPECIFYING CONTROL
TRANSMITTING DATA GENERATING PART
11
CHANNEL ENCODER
12
SERIAL-TO-PARALLEL CONVERTING PART (VARIABLE RATE PART)
13
SPREADING MODULATION PART
14(1)
SPREADING MODULATION PART
14(m)
COMBINING PART
21
IDFT (IFFT)
22
GUARD-INTERVAL INSERTION
23
LOW-PASS FILTER
24
AMPLIFIER
25
ANTENNA
26

FIG.3

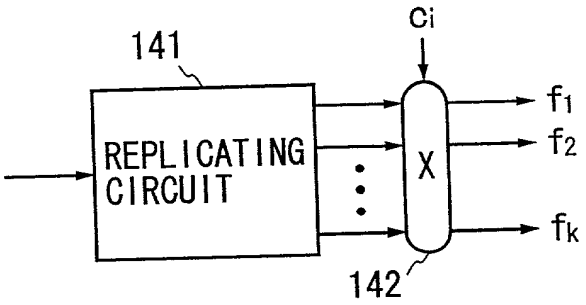

Ci
141
REPLICATING CIRCUIT
X
f1
f2
fk
142

FIG.4

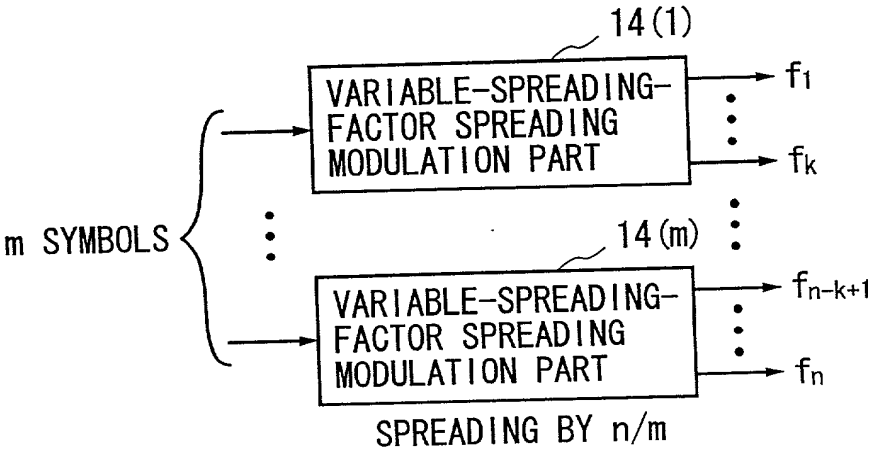

14(1)
VARIABLE-SPREADING-FACTOR SPREADING MODULATION PART
f1
fk
m SYMBOLS
14(m)
VARIABLE-SPREADING-FACTOR SPREADING MODULATION PART
fn-k+1
fn
SPREADING BY n/m

FIG.5A

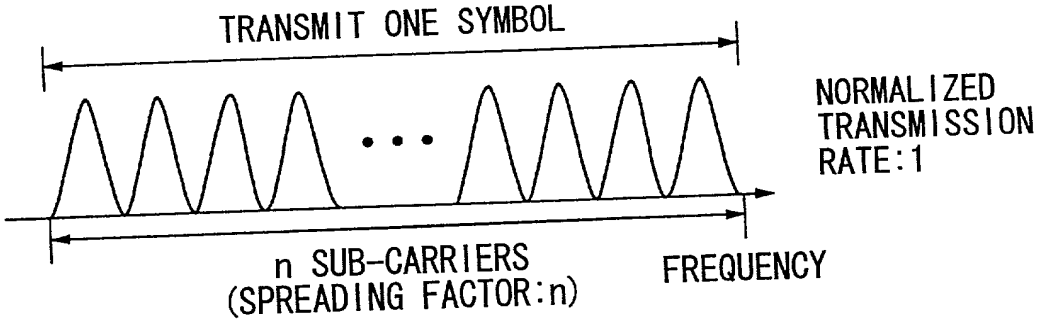

TRANSMIT ONE SYMBOL
NORMALIZED
TRANSMISSION
RATE:1
n SUB-CARRIERS
(SPREADING FACTOR:n)
FREQUENCY

FIG.5B

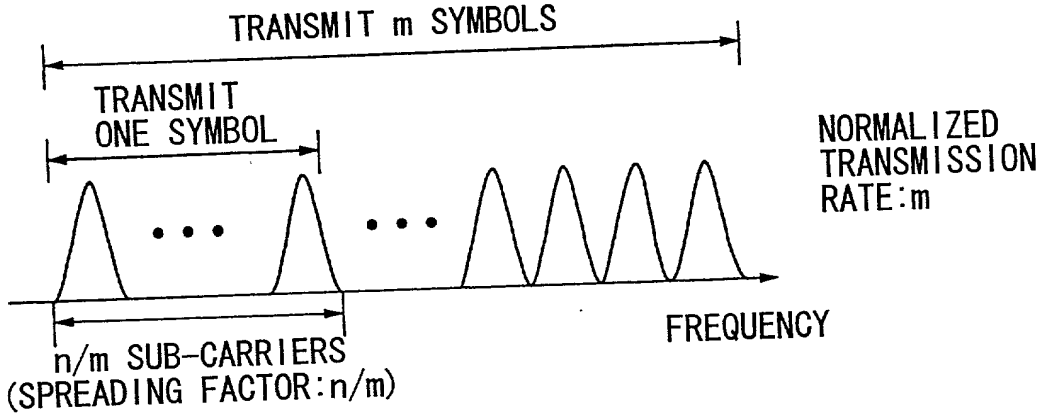

TRANSMIT m SYMBOLS
TRANSMIT
ONE SYMBOL
NORMALIZED
TRANSMISSION
RATE:m
n/m SUB-CARRIERS
(SPREADING FACTOR:n/m)
FREQUENCY

FIG. 6A

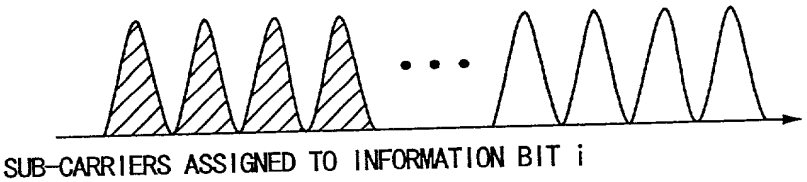

SUB-CARRIERS ASSIGNED TO INFORMATION BIT i

FIG. 6B

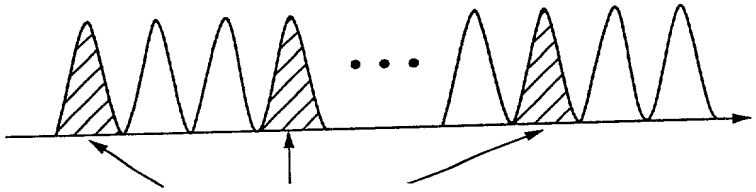

SUB-CARRIERS ASSIGNED TO INFORMATION BIT i

FIG. 7

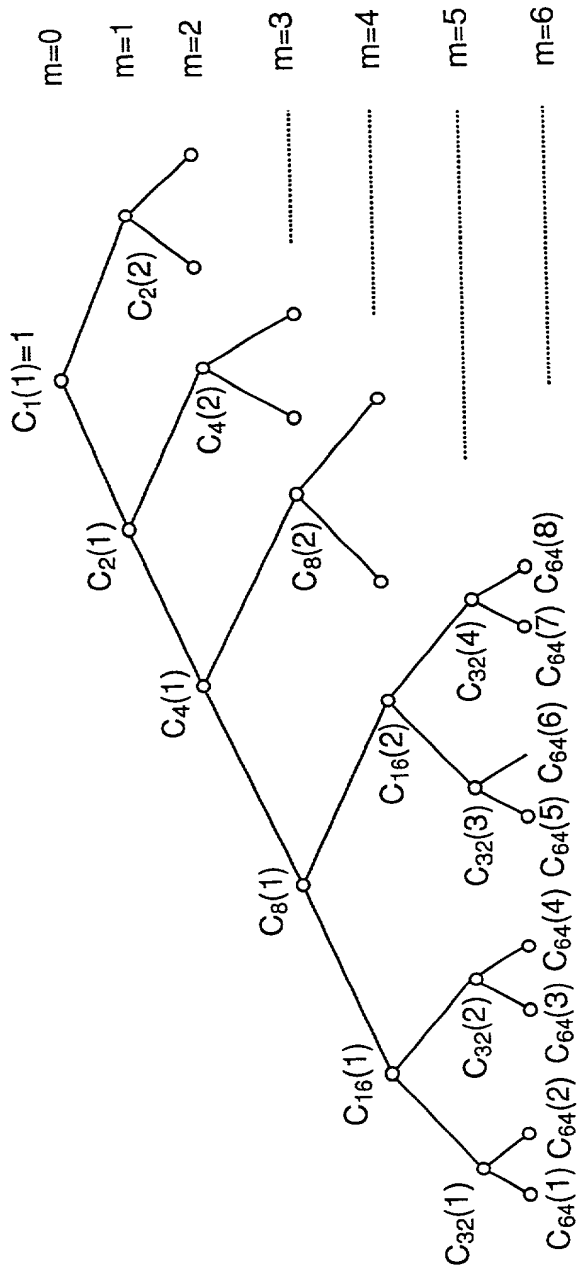

m=0
m=1
m=2
m=3
m=4
m=5
m=6
C1(1)=1
C2(1)
C2(2)
C4(1)
C4(2)
C8(1)
C8(2)
C16(1)
C16(2)
C32(1)
C32(2)
C32(3)
C32(4)
C64(1)
C64(2)
C64(3)
C64(4)
C64(5)
C64(6)
C64(7)
C64(8)

FIG.8

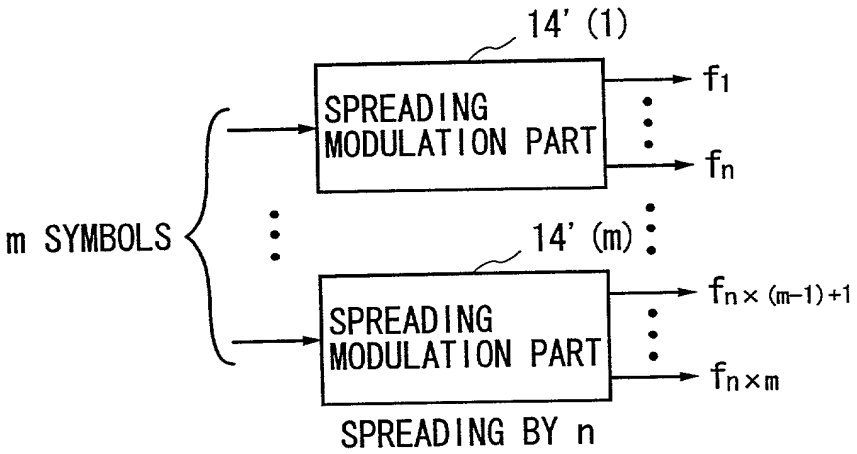

14' (1)
SPREADING MODULATION PART
f1
fn
m SYMBOLS
14' (m)
SPREADING MODULATION PART
fn×(m-1)+1
fn×m
SPREADING BY n

FIG.9A

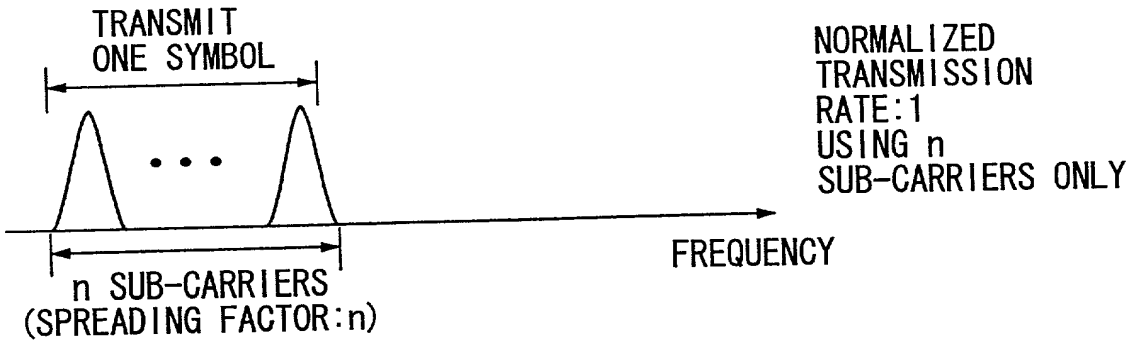

TRANSMIT
ONE SYMBOL
NORMALIZED
TRANSMISSION
RATE:1
USING n
SUB-CARRIERS ONLY
FREQUENCY
n SUB-CARRIERS
(SPREADING FACTOR:n)

FIG.9B

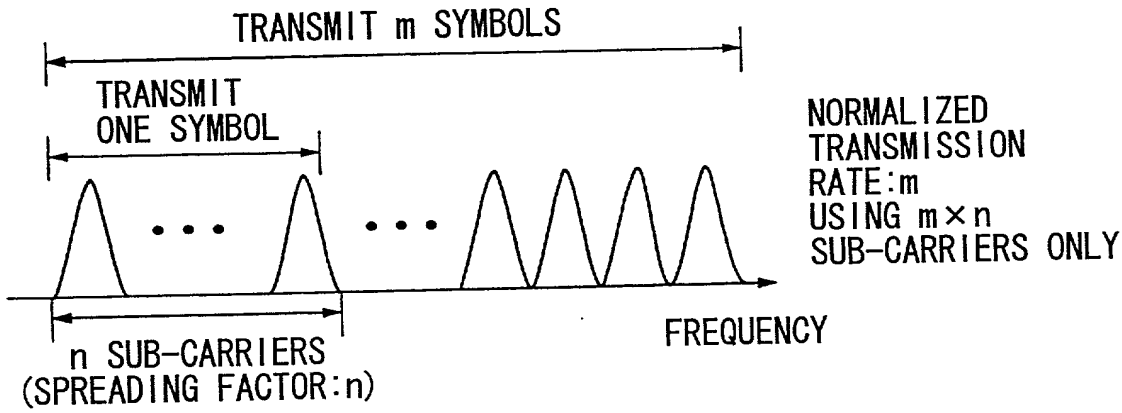

TRANSMIT m SYMBOLS
TRANSMIT
ONE SYMBOL
NORMALIZED
TRANSMISSION
RATE:m
USING m×n
SUB-CARRIERS ONLY
FREQUENCY
n SUB-CARRIERS
(SPREADING FACTOR:n)

FIG.10

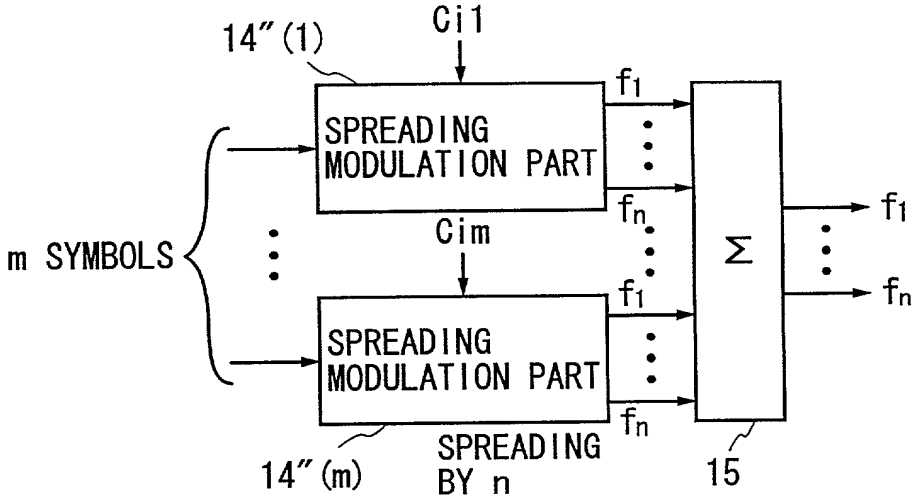

14″(1)
Ci1
SPREADING MODULATION PART
f1
fn
m SYMBOLS
Cim
SPREADING MODULATION PART
f1
fn
Σ
f1
fn
14″(m)
SPREADING BY n
15

FIG.11A

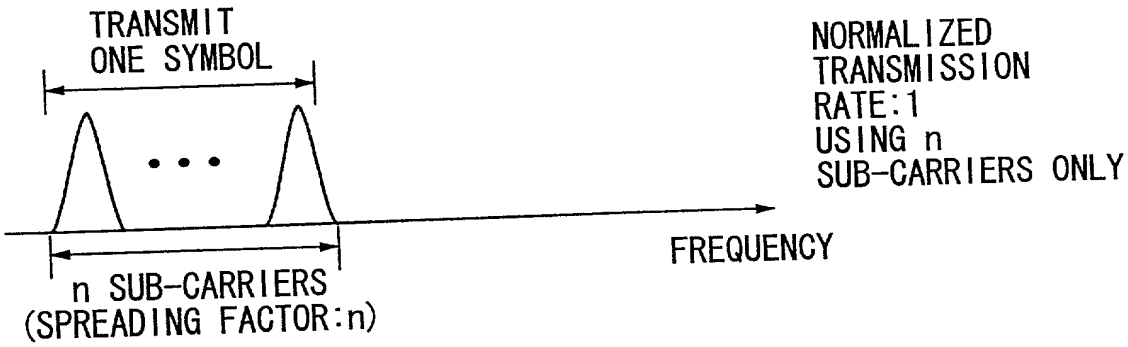


FIG.11B

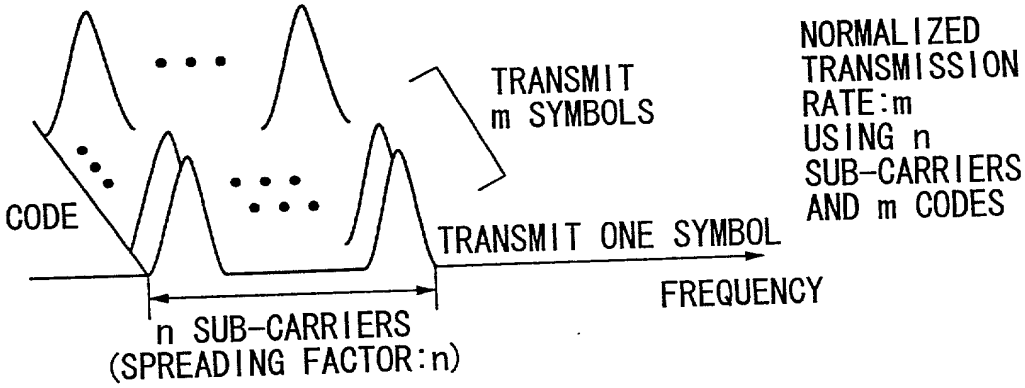


FIG.12

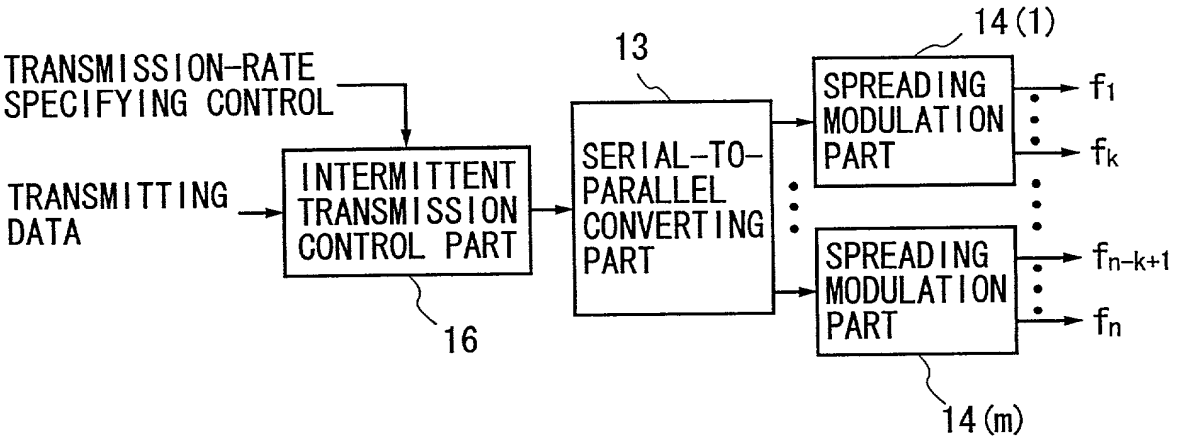


FIG.13A

FIG.13B

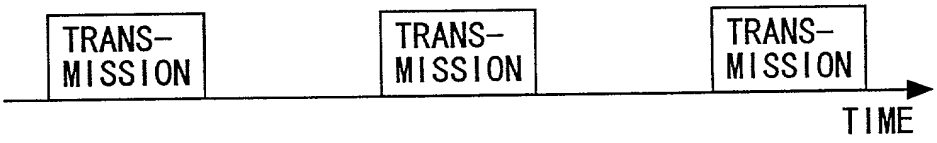


FIG.13C

FIG.14

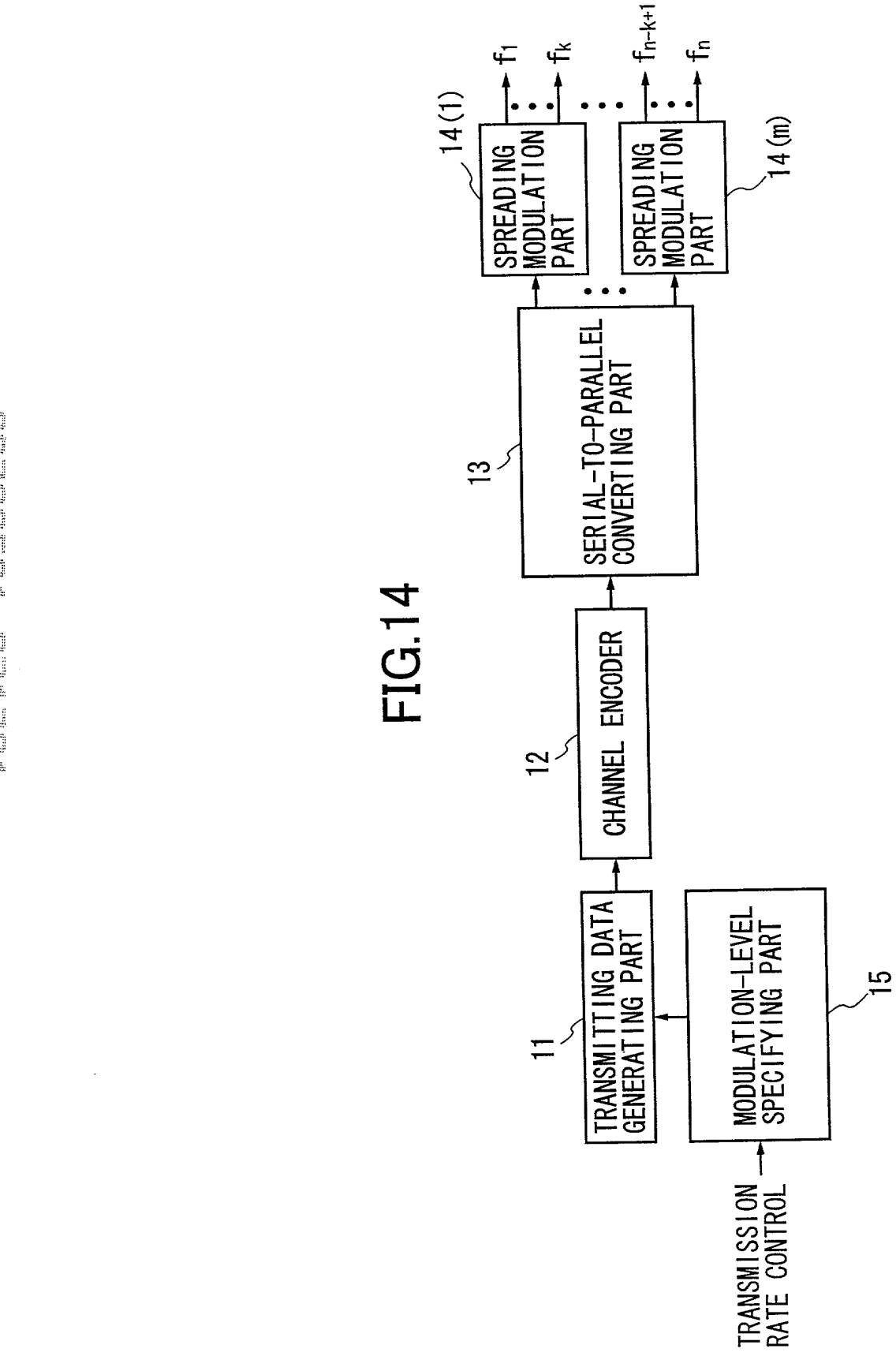

TRANSMISSION RATE CONTROL
MODULATION-LEVEL SPECIFYING PART
15
TRANSMITTING DATA GENERATING PART
11
CHANNEL ENCODER
12
SERIAL-TO-PARALLEL CONVERTING PART
13
SPREADING MODULATION PART
14(1)
SPREADING MODULATION PART
14(m)
f1
fk
fn-k+1
fn

FIG. 15

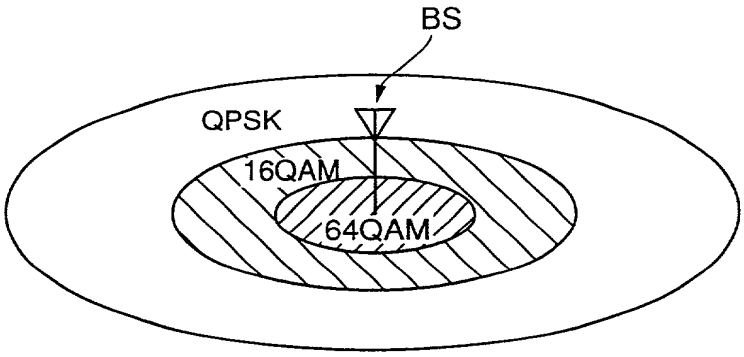


FIG. 16

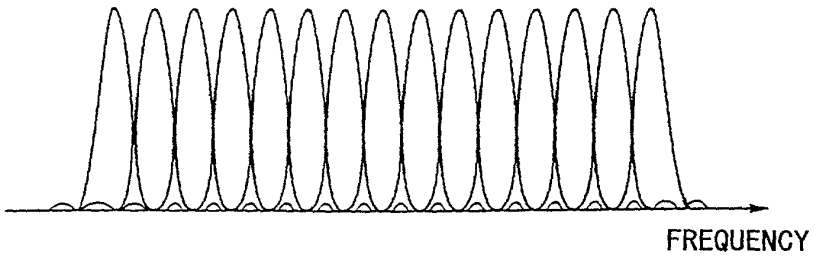


FIG. 17

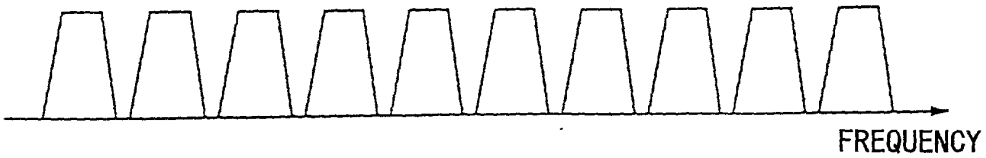


FIG.18

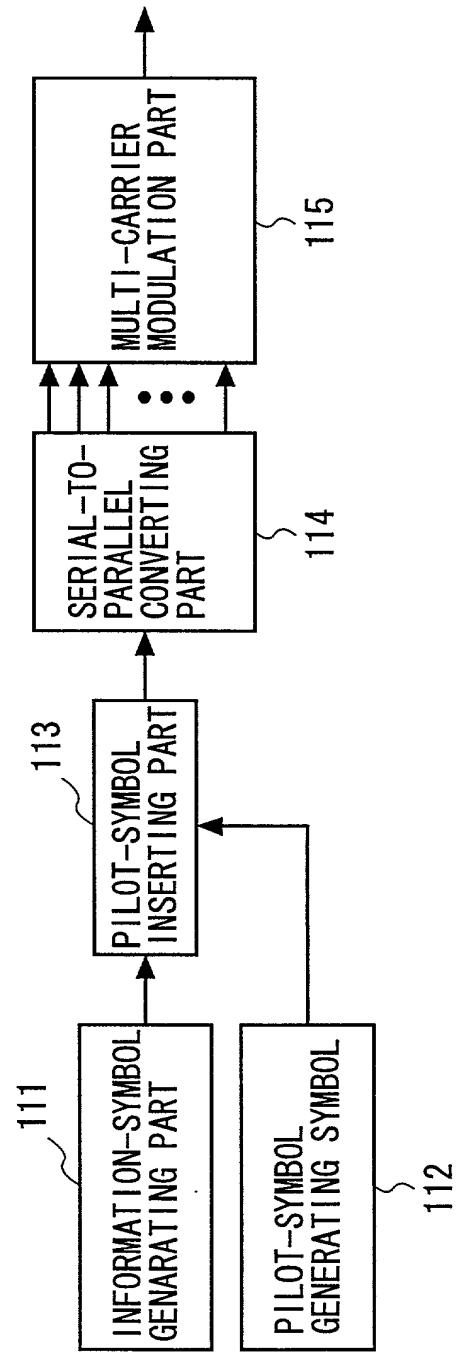

INFORMATION-SYMBOL GENARATING PART
111
PILOT-SYMBOL GENERATING SYMBOL
112
PILOT-SYMBOL INSERTING PART
113
SERIAL-TO-PARALLEL CONVERTING PART
114
MULTI-CARRIER MODULATION PART
115

FIG. 19

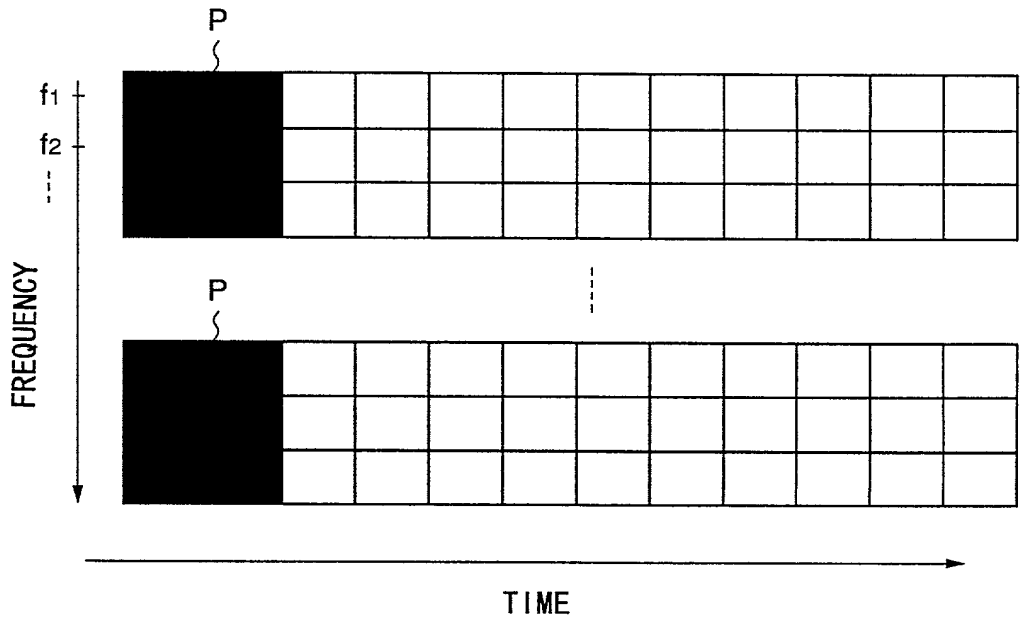


FIG. 20

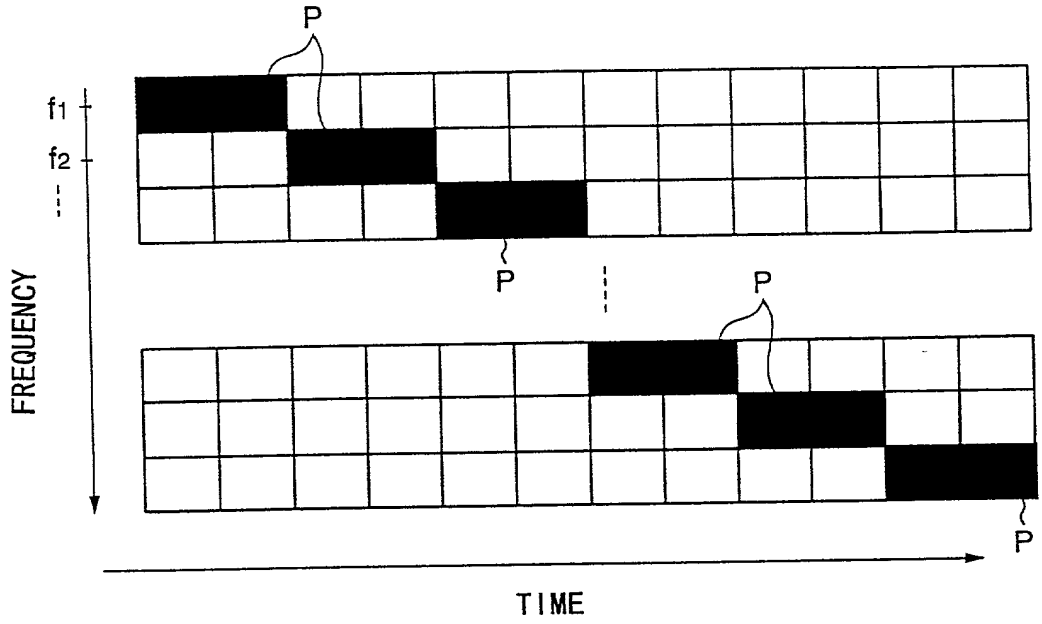

P
f1
f2
P
P
P
FREQUENCY
TIME

FIG.21

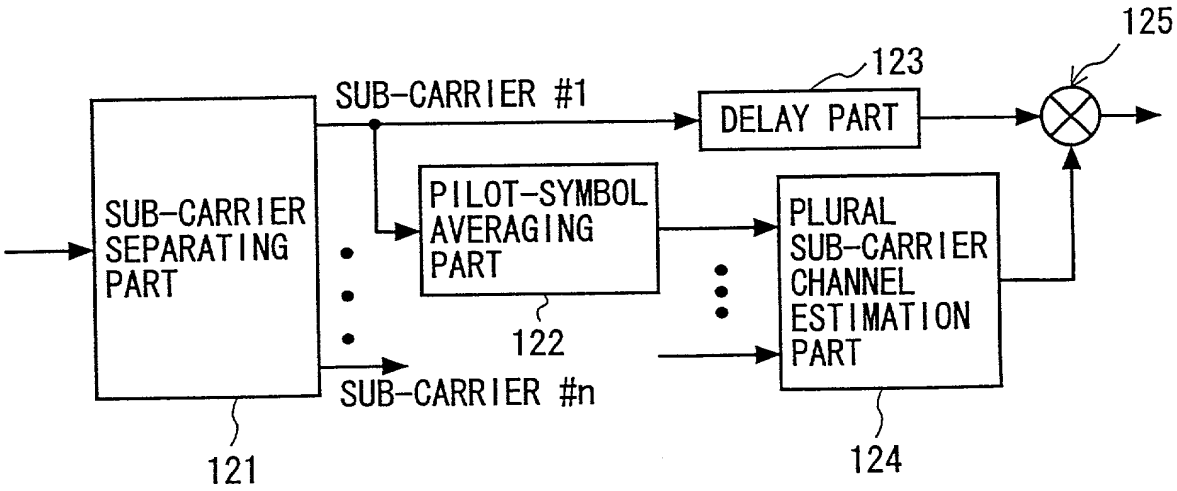
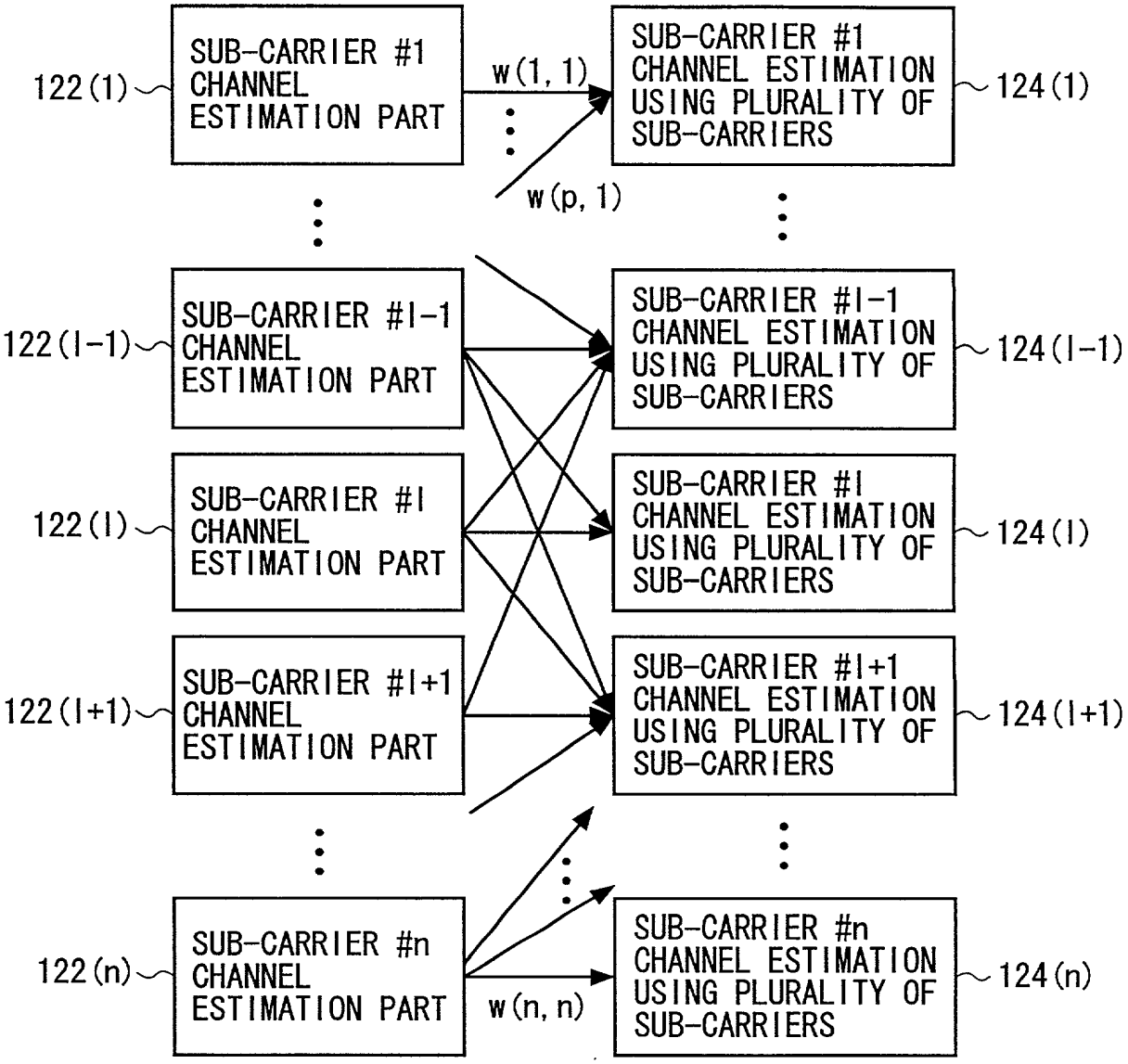

125
123
SUB-CARRIER #1
DELAY PART
SUB-CARRIER SEPARATING PART
PILOT-SYMBOL AVERAGING PART
PLURAL SUB-CARRIER CHANNEL ESTIMATION PART
122
SUB-CARRIER #n
121
124

FIG.22



$$W \cdot \xi = \langle \xi \rangle$$

W : WEIGHTING VECTOR
ξ : CHANNEL ESTIMATION VALUES OBTAINED FROM RESPECTIVE SUB-CARRIERS
$\langle \xi \rangle$: CHANNEL ESTIMATION VALUES FOR RESPECTIVE SUB-CARRIERS OBTAINED THROUGH WEIGHTING AVERAGING

FIG.23

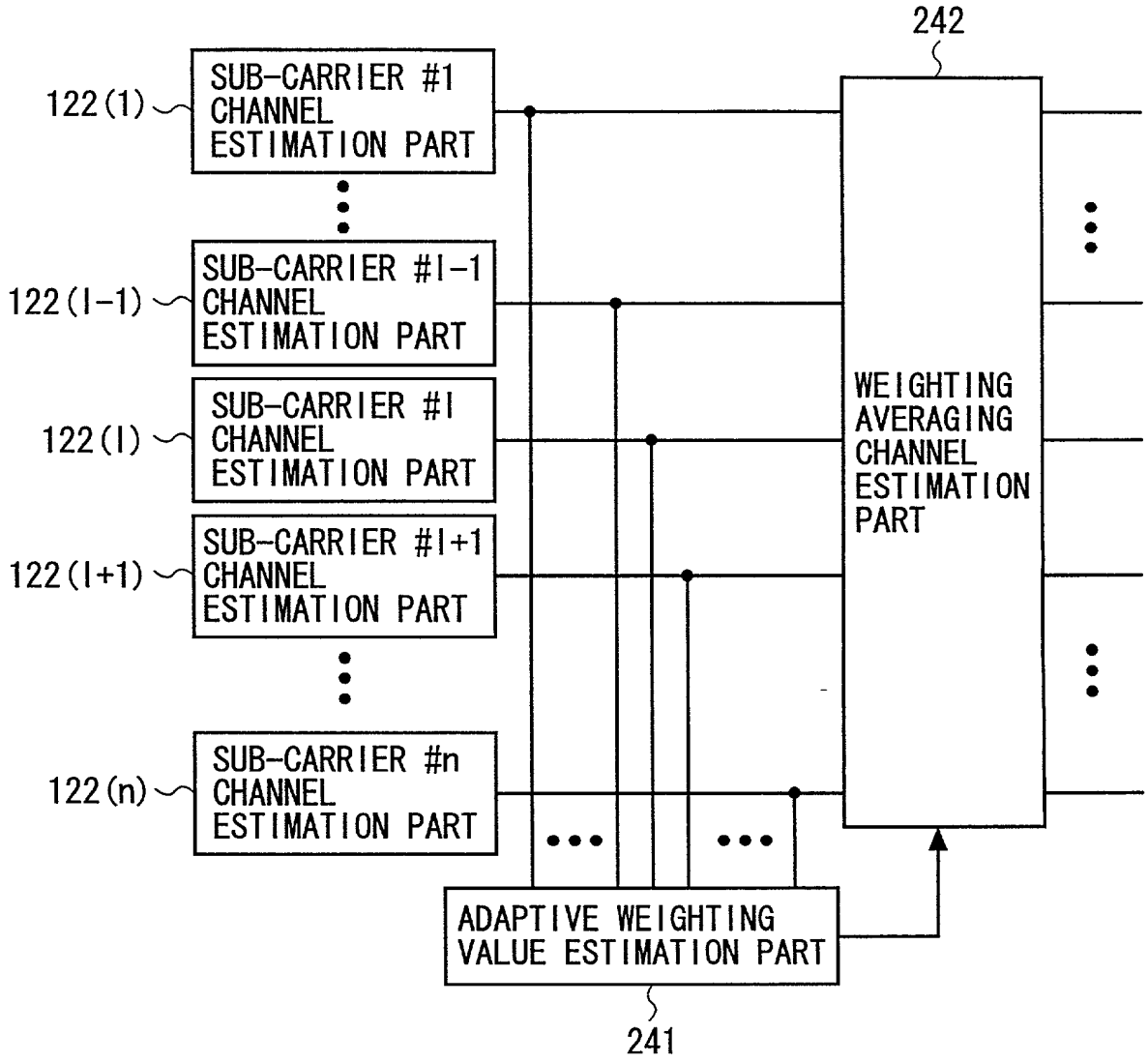
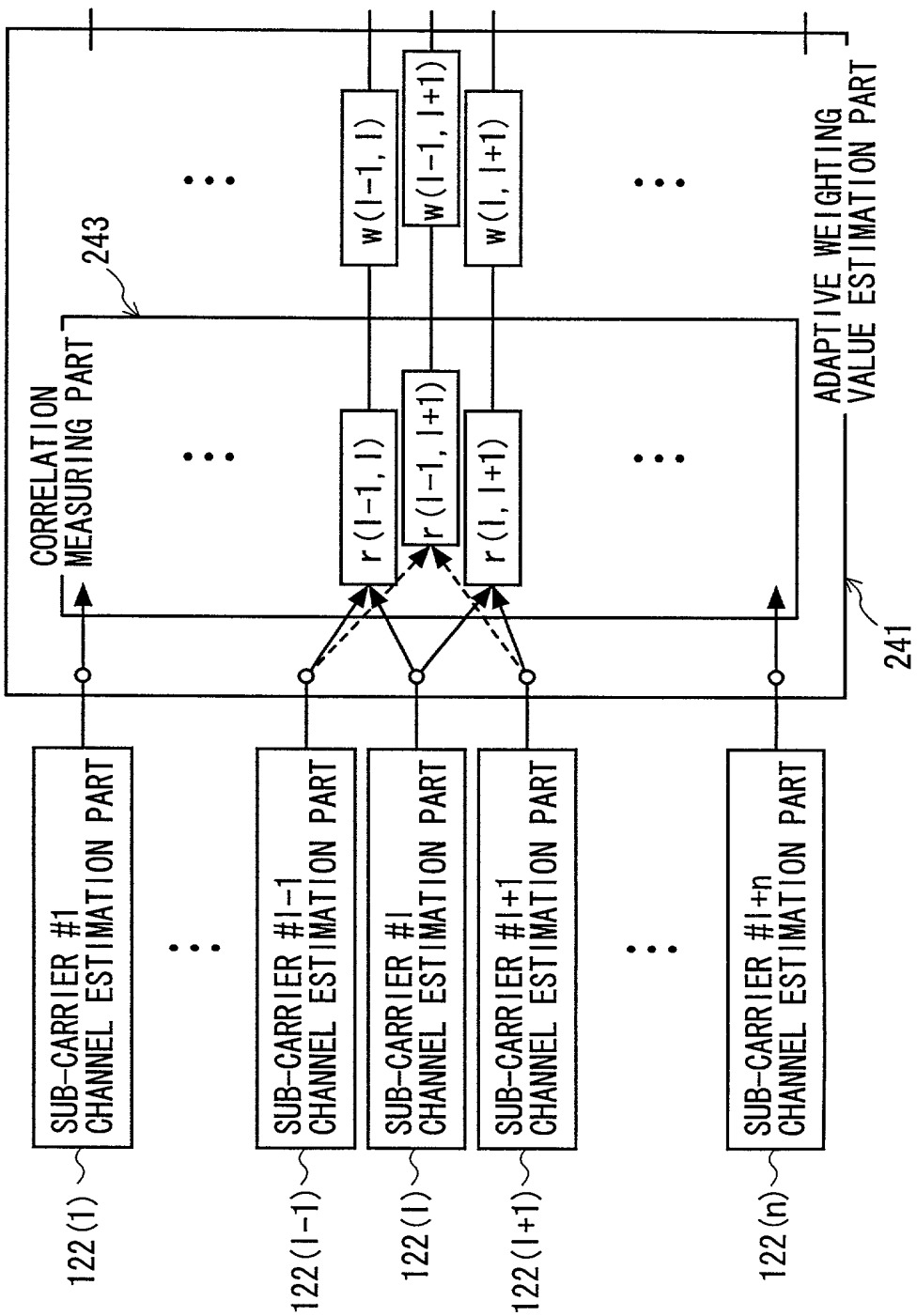

242
122(1)
SUB-CARRIER #1 CHANNEL ESTIMATION PART
122(I-1)
SUB-CARRIER #I-1 CHANNEL ESTIMATION PART
122(I)
SUB-CARRIER #I CHANNEL ESTIMATION PART
122(I+1)
SUB-CARRIER #I+1 CHANNEL ESTIMATION PART
122(n)
SUB-CARRIER #n CHANNEL ESTIMATION PART
WEIGHTING AVERAGING CHANNEL ESTIMATION PART
ADAPTIVE WEIGHTING VALUE ESTIMATION PART
241

FIG.24


SUB-CARRIER #1 CHANNEL ESTIMATION PART
SUB-CARRIER #l-1 CHANNEL ESTIMATION PART
SUB-CARRIER #l CHANNEL ESTIMATION PART
SUB-CARRIER #l+1 CHANNEL ESTIMATION PART
SUB-CARRIER #l+n CHANNEL ESTIMATION PART
122(1)
122(l-1)
122(l)
122(l+1)
122(n)
CORRELATION MEASURING PART
243
r(l-1, l)
r(l-1, l+1)
r(l, l+1)
w(l-1, l)
w(l-1, l+1)
w(l, l+1)
ADAPTIVE WEIGHTING VALUE ESTIMATION PART
241